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TEST AND EVALUATION OF AIR/GROUND COMMUNICATIONS FOR HELICOPTER--ETC(U)
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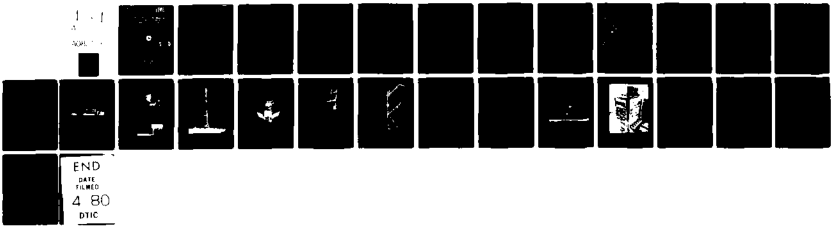

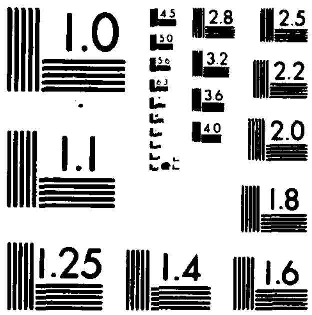

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

Report No. FAA-RD-79-123

12 LEVEL II

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TEST AND EVALUATION OF AIR/GROUND COMMUNICATIONS FOR HELICOPTER OPERATIONS IN THE OFFSHORE NEW JERSEY, BALTIMORE CANYON OIL EXPLORATION AREA

James J. Coyle

DEPARTMENT OF TRANSPORTATION · UNITED STATES OF AMERICA

INTERIM

JANUARY 1980

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Prepared for

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16. Abstract

Helicopter instrument flight rules (IFR) operations in the offshore oil drilling areas are creating a need for low-level extended range air/ground (A/G) communications. This report describes the communications equipment and concepts used for helicopter IFR operations in the offshore New Jersey, Baltimore Canyon oil exploration area. Various types of very high frequency (VHF) high-gain directional antenna arrays were installed and flight tested to determine the degree of A/G communications coverage provided. Both the flight test data and more than 1 year of operational experience have shown that reliable A/G communications that can support IFR operations are obtainable throughout the offshore New Jersey oil exploration area by using high-gain directional antennas.

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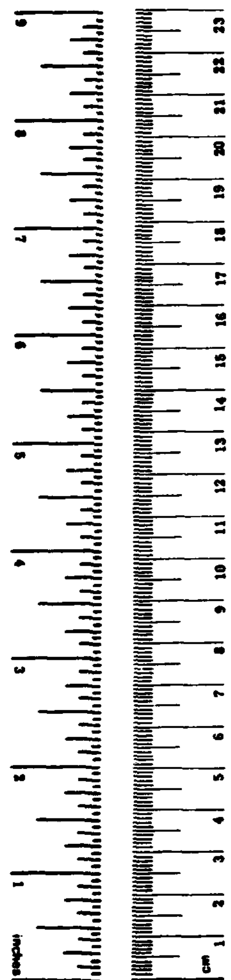
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

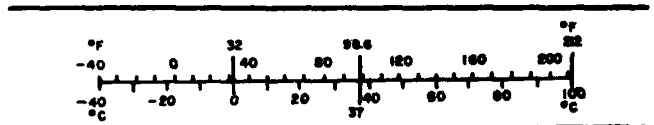
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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INTRODUCTION

PURPOSE.

The purpose of this project was to test and evaluate the air/ground (A/G) communications equipment and concepts used for helicopter instrument flight rules (IFR) operations in the offshore New Jersey, Baltimore Canyon oil exploration area, and to investigate alternative communications systems for helicopter low-level and over-water operations.

BACKGROUND.

Helicopter IFR operations are a rapidly growing segment of the National Airspace System (NAS) with a projected tenfold increase within the next 10 years. To support this activity, the Federal Aviation Administration (FAA) established a helicopter operations development program with an overall objective of improving the NAS so as to enable helicopters to employ their unique capabilities to the maximum practical extent. Details of the helicopter IFR operations development program plan are included in Report No. FAA-RD-78-101, dated September 1978.

Major issues have been identified in the helicopter operations development plan for study and analysis. These issues are communications, navigation, air traffic control (ATC) procedures, weather/icing, and IFR certification. The communications study and analysis requirements addressed in this report include the methods by which information, such as clearances, unique weather information, and position reports are conveyed between air and surface elements of the system, especially where the communications link extends beyond line-of-sight. The line-of-sight considerations are extremely important with helicopter operations, due to their unique low-altitude flight characteristics and the remote locations they service, such as oil rigs.

A project for improving helicopter A/G communications was established at the National Aviation Facilities Experimental Center (NAFEC). The project was directed toward the evaluation of existing and alternative communications systems, with respect to their applicability to helicopter IFR, low-level, and over-water operations. Initial NAFEC project test objectives were to collect as much flight test data and operational information as possible to support recommended criteria for approval of helicopter IFR operations in the eastern offshore oil exploration area. The technical approach consisted of researching technical options available for offshore communications, investigating existing communications systems, determining ATC communications requirements, and flight testing the existing and proposed helicopter routes to determine their A/G communication coverage.

DISCUSSION

<u>GENERAL</u>.

Helicopter operations in the offshore New Jersey oil exploration area are similar to helicopter oil-supporting operations in Alaska, California, and the Gulf of Mexico. Regular helicopter flights are made to oil rigs located from 70 to 100 nautical miles (nmi) off the coast for the purpose of transfering personnel, providing for emergency evacuations, geological monitoring, and resupply. The two helicopter companies which have been or are currently operating in the offshore New Jersey oil exploration area are United Helicopters and Petroleum Helicopters, Inc. (PHI). United Helicopters operated out of the Atlantic City-NAFEC (ACY) Airport and PHI operates out of the Atlantic City Municipal Airport (AIY) Bader Field. One of the PHI helicopters was based at the Wildwood-Cape May County (WWD) Airport for a period of time to service an oil drilling rig located 75 nmi east of Cape May, New Jersey.

The oil drilling rigs which have been or are currently operating in the offshore New Jersey oil exploration area are:

Glomar Pacific, contracted to Exxon.

Diamond M New Era, contracted to Conoco/Gulf.

Ocean Victory, contracted to Texaco.

Western Pacesetter II, contracted to Mobil.

Sedco J, contracted to Houston.

Western Pacesetter III, contracted to Mobil.

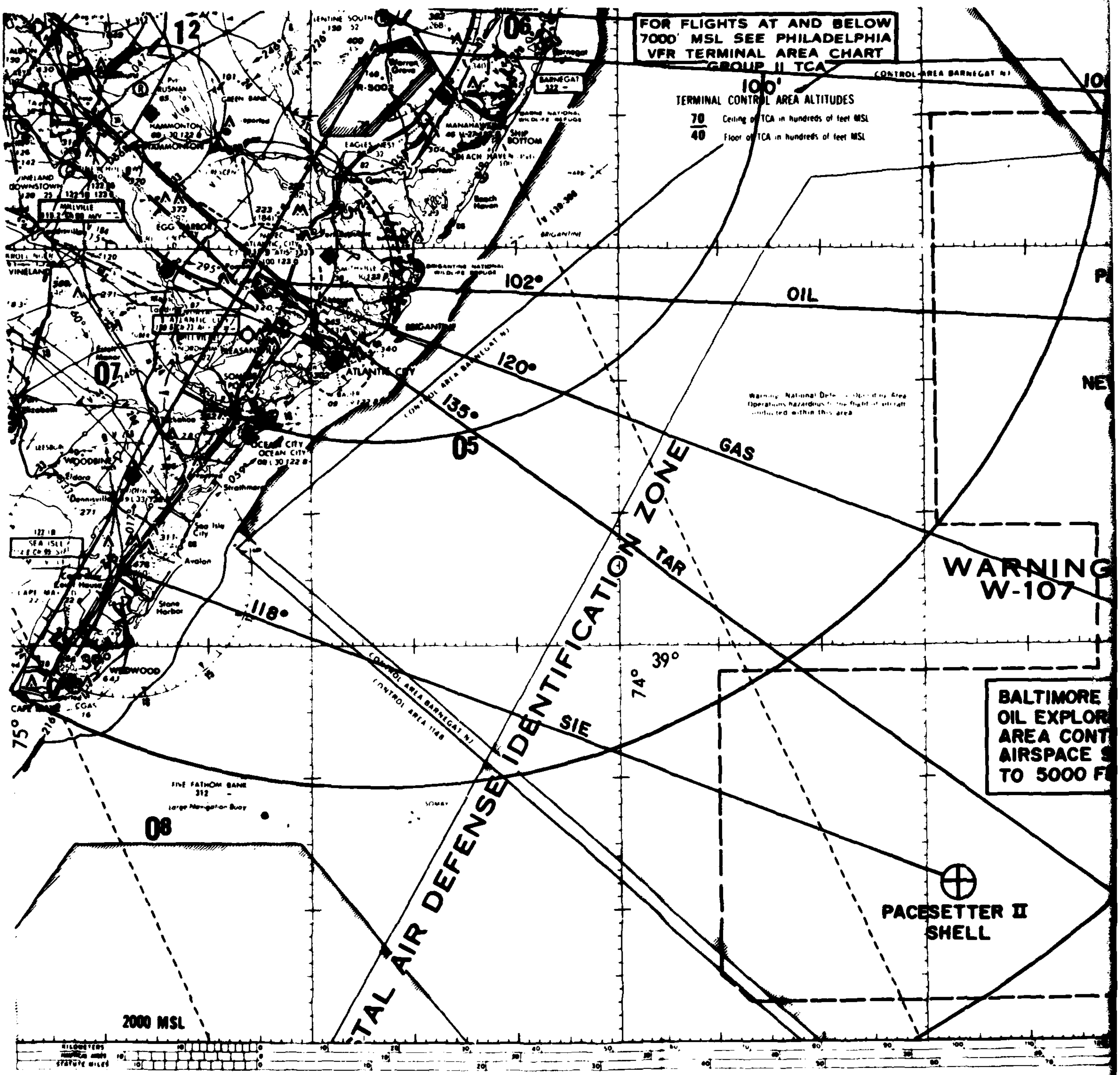
Ben Ocean Lancer, contracted to USGS for continental offshore strategraphic tests (COST).

Diamond M Epoch, contracted to Exxon.

Glomar Semi I, contracted to Exxon.

Zapata Ugland, contracted to Tenneco.

Figure 1 is a reproduction of a section of the Washington sectional aeronautical chart which was modified to show the location of the eight oil drilling rigs on January 1, 1979, outlines of the controlled airspace for the offshore New Jersey oil exploration area, the four designated helicopter routes to the oil rigs, and the VHF radio line-of-sight A/G communications coverage limits at indicated altitudes, from the 100-foot above ground level (AGL) antenna array at Warren Grove, N. J.



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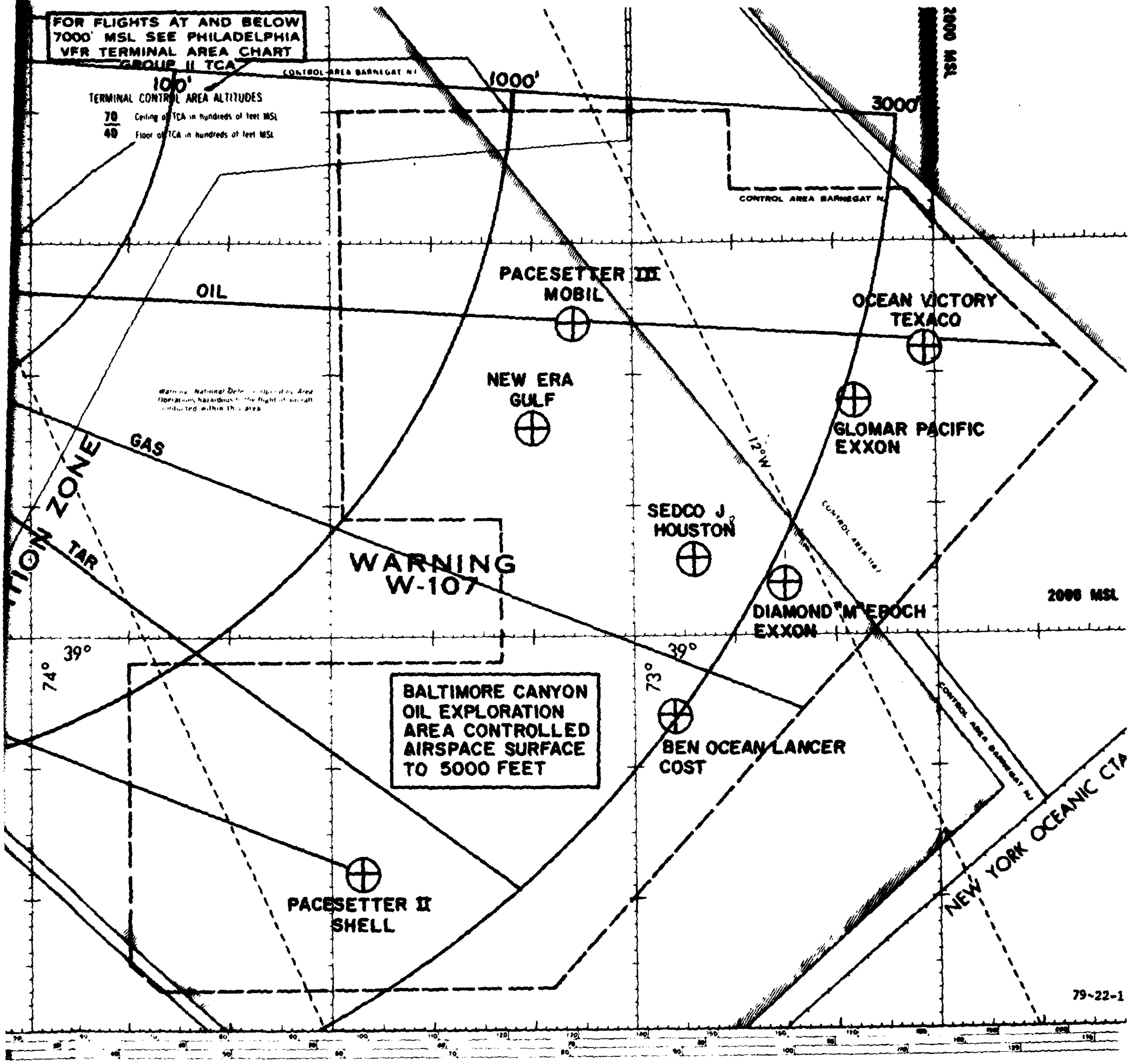

FIGURE 1. HELICOPTER OPERATIONS AREA

LINE-OF-SIGHT CONSIDERATIONS.

Line-of-sight propagation characteristics for radio waves in the VHF aeronautical mobile band (118 to 136 megahertz (MHz)) are similar to that of light rays and generally follow the same geometrical, optical, or visual line-of-sight laws. However, due to the refraction of radio waves by the atmosphere, reliable communication paths can be obtained beyond the optical line-of-sight range. This extended range is known as the radio line-of-sight range and will decrease as the frequency increases or increase as the frequency decreases.

Variations of terrain, temperature, and moisture in the atmosphere have also been found to have an effect on radio waves. For a mean climatic condition, such as the offshore New Jersey oil exploration area, the path of a radio wave could be plotted as a straight line if the earth's radius is increased by a factor of 4/3 or 1.33. This factor, known as k, may vary from 1.1 in cold dry climates, such as the oil exploration area on the north slope of Alaska, to 1.6 in the hot humid climates near the equator. For a k value of 4/3, the approximate distance to the radio horizon can be computed with the equation: $D = 2\ Hrk$

where D = Distance to radio horizon in feet
H = Height of antenna above ground in feet
r = Earth's radius in feet
$k = 4/3$

The earth's radius is approximately 3,960 miles and 4/3 of this value will give an rk value of 5,280 miles. However, since 5,280 ft equals 1 mile, this value can also be expressed as $5{,}280^2$ feet. To convert D into miles, both sides of the equation are divided by 5,280 and the equation now simplifies to:

$$D(\text{miles}) = \sqrt{2\ H\ (\text{feet})}$$

Figure 2 is a nomogram using the above equation for computing the radio line-of-sight distances in miles over a smooth earth with the height of the transmitting and receiving antennas measured in feet above mean sea level (m.s.l.) ground. When a straight line is drawn from the scale value in feet for the transmitting antenna height to the scale value in feet for the receiving antenna height, the radio line-of-sight value in miles can be read from the center scale. The dashed lines on the nomogram show the radio line-of-sight distances in miles, on the center scale, that can be obtained from the FAA antenna array at the 100-foot level on the Warren Grove tower, the base of which is 100 feet above sea level giving an antenna height of 200 feet m.s.l. when the helicopter is on the ground or flying at 100 feet m.s.l., 1,000 feet m.s.l., or 3,000 feet m.s.l.

The radio line-of-sight values in figure 2 are included in figure 1 to assist in defining the communications coverage limits. To provide VHF radio communications beyond the radio line-of-sight horizon, a stronger RF signal is required to compensate for the greater than 6 dB per octave signal attenuation that occurs.

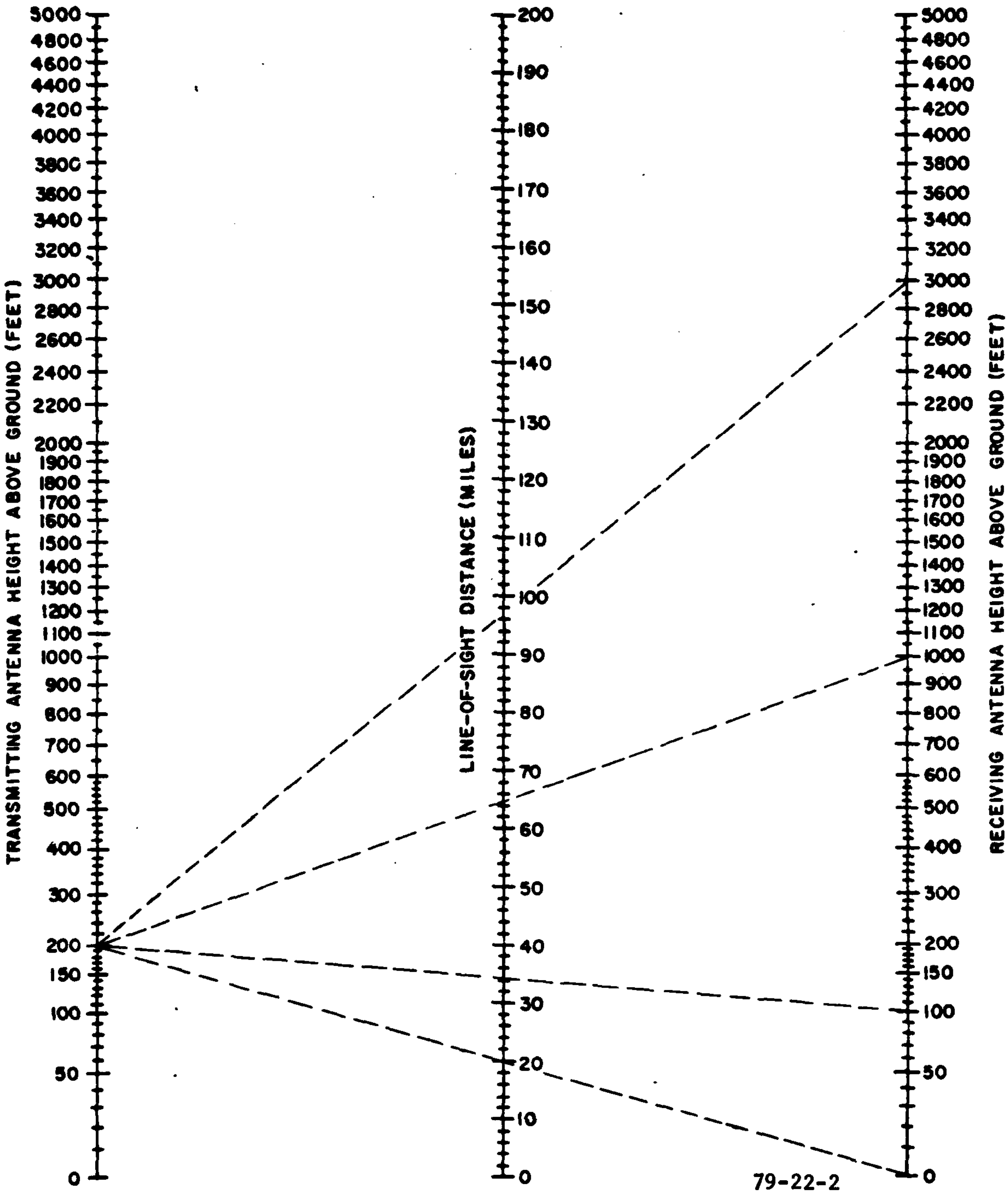

FIGURE 2. LINE-OF-SIGHT DISTANCE NOMOGRAM FOR ELEVATED ANTENNAS 0-5,000 FEET

AIR/GROUND COMMUNICATIONS FACILITIES.

Helicopter pilots require direct communications with both ATC and company radio facilities for safe and efficient operations. ATC communications are presently accomplished in the VHF aeronautical mobile band between the frequencies of 118.0 and 135.975 MHz. Communications with company facilities are accomplished in a portion of the VHF aeronautical mobile band between 128.825 and 132.0 MHz and on various other VHF and high-frequency (HF) channel assignments. Company communications are accomplished using aeronautical land radio stations which are licensed to Aeronautical Radio Incorporated (ARINC).

ARINC, a corporation whose principle stockholders are the United States (U.S.) scheduled airlines, operates a system of aeronautical land radio stations, both within the continental United States and overseas, that are available to all aircraft operators. Most helicopter operators including both PHI and United Helicopters are members of ARINC. The assignment of frequencies are duplicated, both on the ground and in the air, and since the aircraft radio stations are, in each case, licensed to the aircraft operators, the licensing procedures and related matters are closely and continuously coordinated in ARINC.

Figure 3 is a chart from appendix 1 of FAA Advisory Circular No: 91-52, dated June 21, 1978, which shows the VHF radio coverage available from FAA and ARINC facilities in the oceanic airspace off the coast of the conterminous United States. A circle has been added to this chart to show the relative size of the offshore New Jersey helicopter operations area, with respect to the VHF communications coverage provided at higher altitudes.

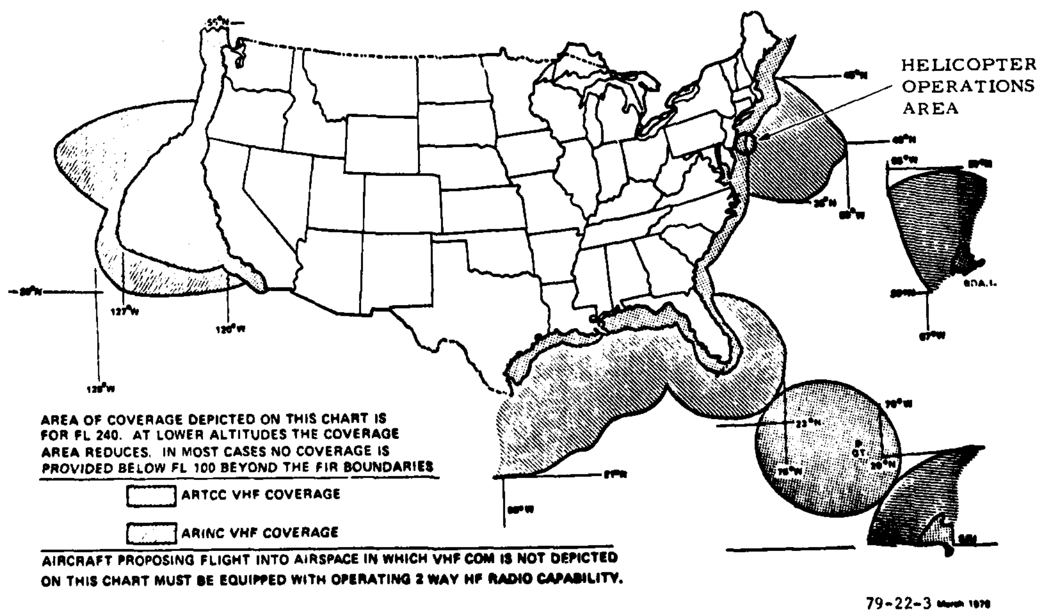

FIGURE 3. VHF COVERAGE IN OCEAN AIRSPACE

Figure 4 shows some of the A/G communications antennas located at Bader Field. The HF and VHF antennas on the roof of the hangar are connected to PHI's communications equipment located inside the hangar, and the VHF swastika antenna on the right side of the hangar is used by Atlantic City tower (ACY) for a clearance delivery frequency.

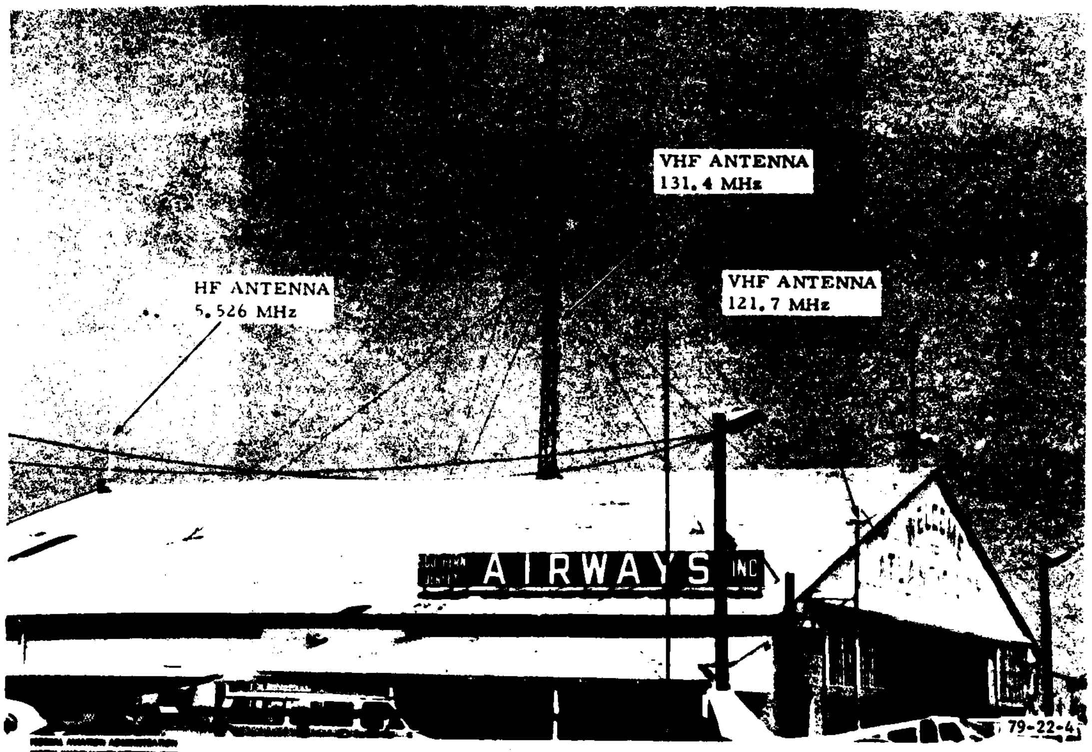

FIGURE 4. PHI/FAA ANTENNA INSTALLATION--BADER FIELD

Figure 5 shows an array of ARINC's high-gain directional Yagi antennas that are used to provide extended range VHF communications coverage on 131.85 MHz in the northeast ocean airspace (as shown in figure 3). This antenna array is located on the roof of the Brigantine Hotel, 6 miles north of Bader Field, and consists of 12 TACO SY41-129 screen Yagi antennas phased together with a stacking harness.

Figure 6 shows the Exxon high-gain VHF directional Yagi antenna on the roof of the Vassar Square apartment building in Ventnor, New Jersey, located approximately 3 miles south of Bader Field. This antenna was connected to a 300-watt frequency modulated (FM) transceiver and provided a VHF communications channel on 33.36 MHz between the PHI operations trailer at Bader Field and the Glomar Pacific Oil drilling rig.

Figure 7 shows a 300-foot FAA communications tower located in Warren Grove, New Jersey. Various VHF high-gain directional antennas were installed on this tower for operational service and to investigate A/G communications coverage limits in the offshore oil exploration area.

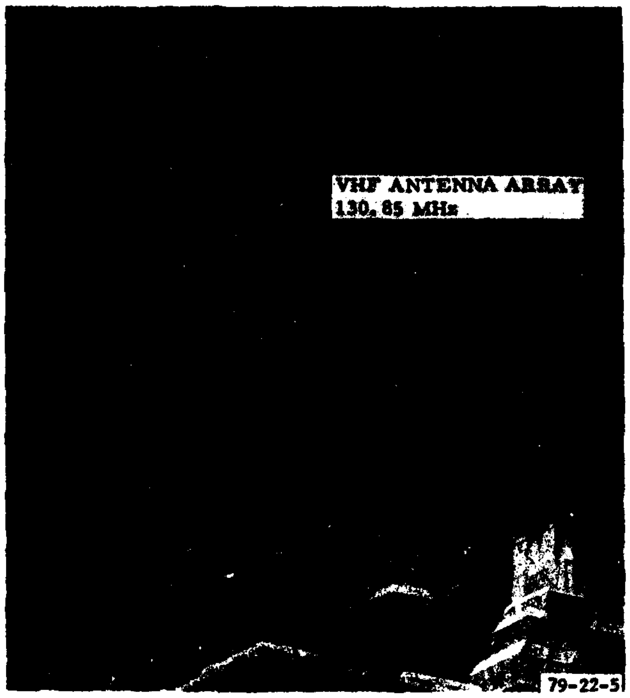

FIGURE 5. ARINC ANTENNA INSTALLATION--BRIGANTINE HOTEL

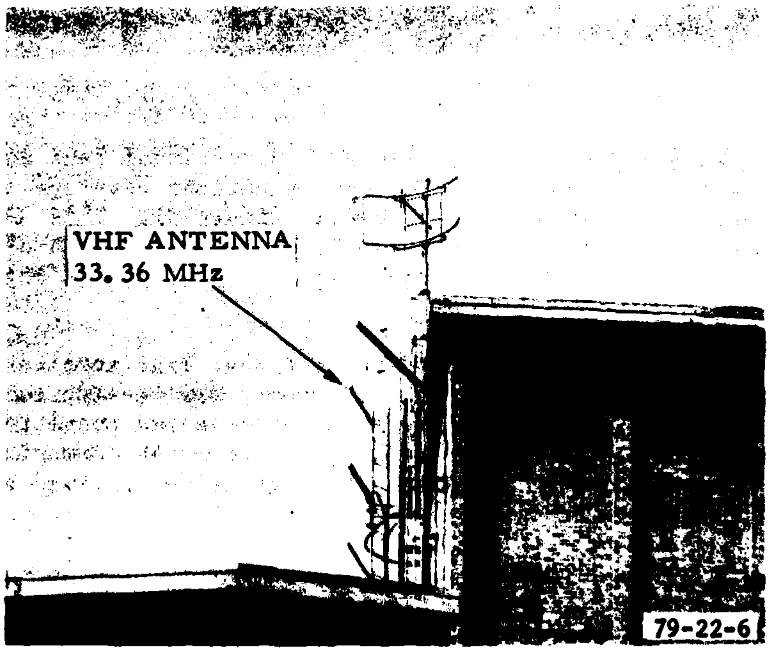

FIGURE 6. EXXON ANTENNA INSTALLATION--VASSAR SQUARE

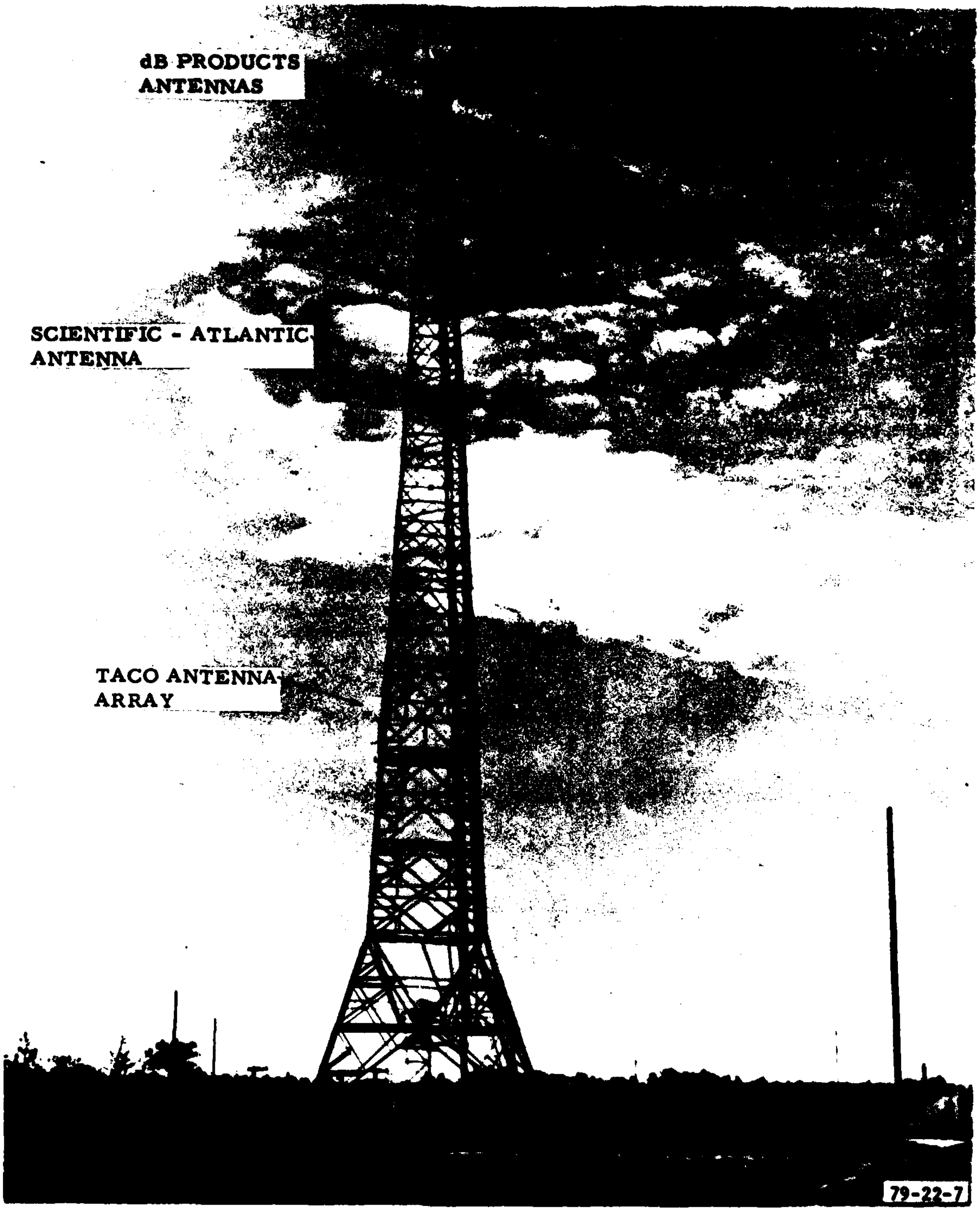

FIGURE 7. FAA ANTENNA INSTALLATION--WARREN GROVE

Figure 8 is a closeup photograph of the dB-224E antennas located at the 300-foot level of the FAA communications tower. These antennas are used for ATC helicopter operations on 133.6 MHz.

FIGURE 8. DECIBEL PRODUCTS dB-224E ANTENNAS

Figure 9 shows a Scientific-Atlanta model 20-1 log periodic 10 dB gain antenna installed at the 200-foot level of the communications tower. This antenna was used for frequency and space diversity test measurements.

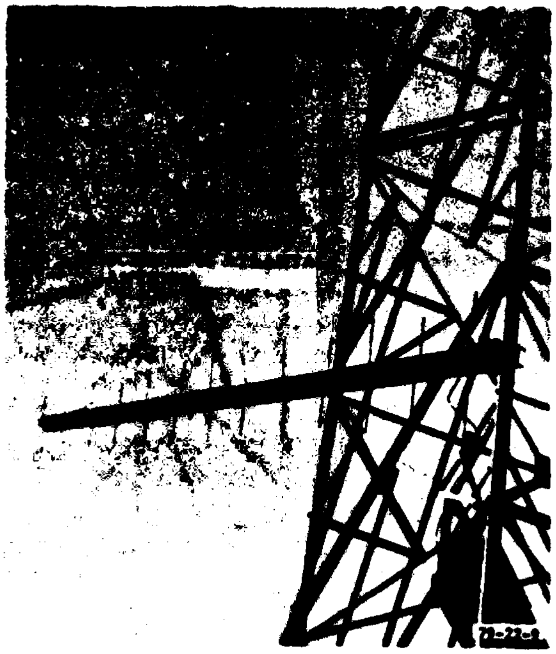

FIGURE 9. SCIENTIFIC-ATLANTA LOG-PEROIDIC ANTENNA

Figure 10 shows an array of TACO model SY-41-129 screen YAGI antennas installed at the 100-foot level of the communications tower. These antennas were vertically stacked to reduce the vertical radiation pattern and provide approximately 16 dB of gain.

Figure 11 shows an FAA specified TACO model Y-102B 10 dB gain directional antenna. This antenna was installed on the Glomar Semi I and Ocean Victory oil drilling rigs to permit over the horizon test measurements.

The dB 224E antenna shown in figure 8 is the same type of antenna that is used by PHI for company communications at Bader Field and throughout the Gulf of Mexico. The TACO SY 41-129 screen YAGI antennas shown in figure 10 are the same type that are being used by ARINC for extended range VHF coverage in ocean airspace, as shown in figure 3. The measured technical characteristics of the dB 224E, TACO SY-41-129, and TACO Y-102B antennas can be found in FAA report number NA-77-39, dated June 1978.

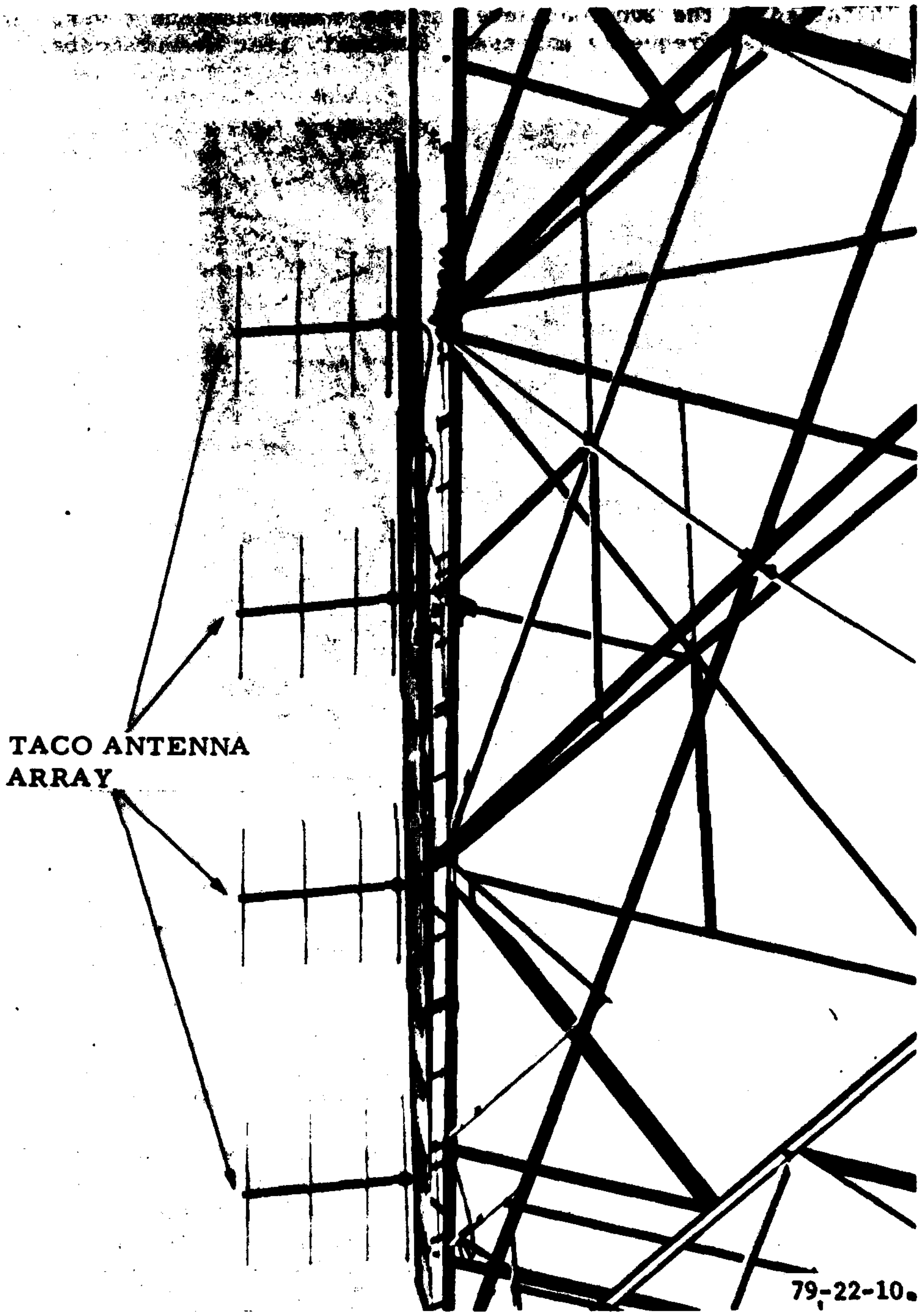

FIGURE 10. TACO SY 41-129 ANTENNA ARRAY

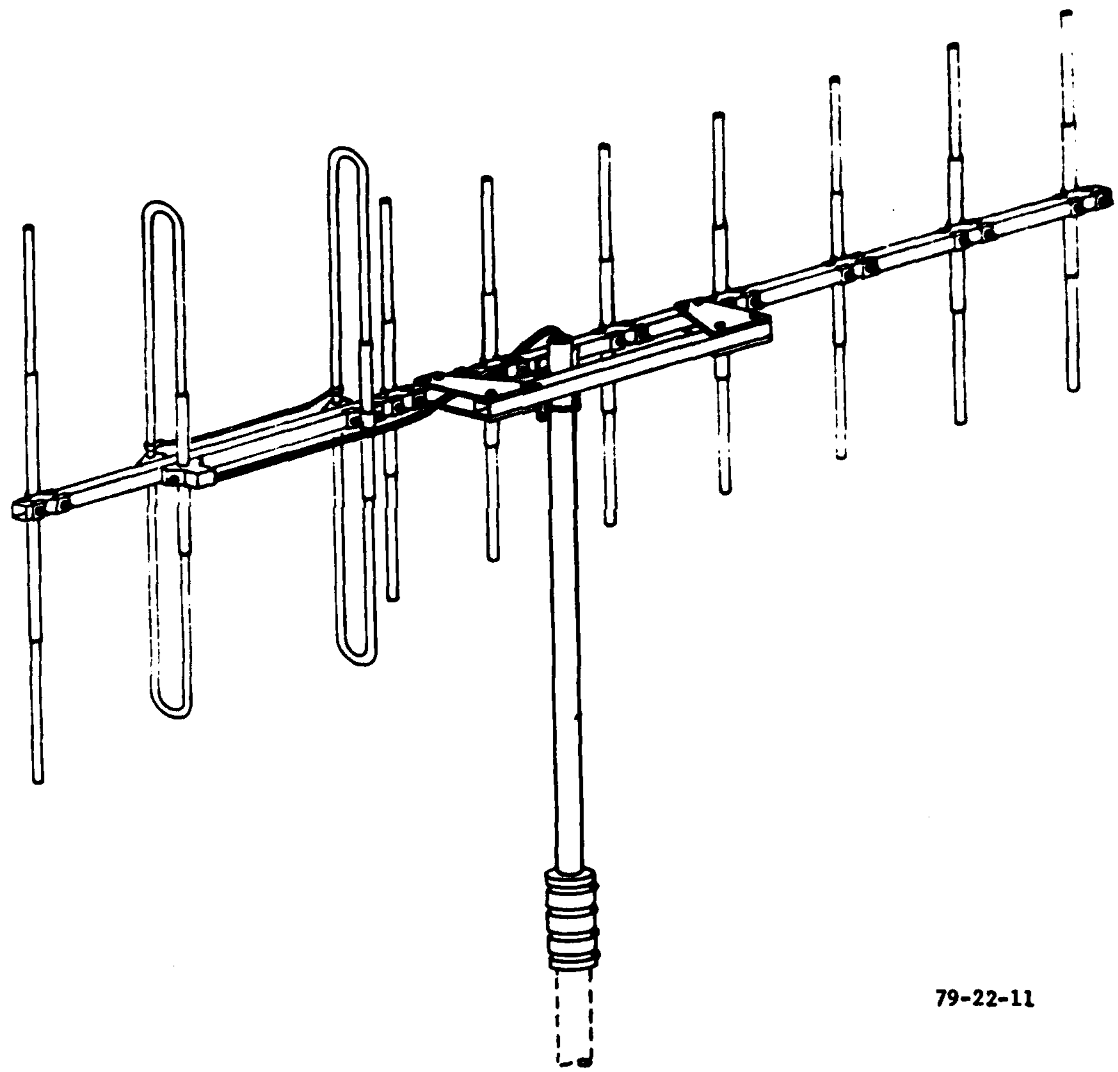

FIGURE 11.   TACO Y102B-130V ANTENNA

ATC/HELICOPTER COMMUNICATIONS INTERFACE.

When helicopter IFR operations started in the offshore New Jersey oil exploration area, a typical flight to an oil rig would consist of the pilot filing an IFR flight plan to the desired oil rig via a distance measuring equipment (DME) fix on one of the VOR radials (oil, gas, tar or SEI) as shown in figure 1. The helicopter would depart from either ACY, AIY, or WWD airport and fly under ACY tower departure control, communicating with ATC on 118.35, 119.55 or 124.6 MHz. At 40 miles DME from the ACY VORTAC, control would be transfered from ACY tower to New York Center and the helicopter pilot would then communicate with New York Center on 132.15 MHz. At approximately 10 miles from the destination oil rig, the helicopter pilot would get an ATC clearance to land from New York Center and enter a helicopter en route descent area (HEDA) for his destination oil rig.

Within the HEDA, the helicopter pilot would contact his company radio operator, who is also a U.S. National Weather Service Certified Meteorologist, and obtain the local altimeter, winds, weather, and other necessary information. United helicopter pilots would communicate with their company radio operator on the Pacesetter III, using the ARINC licensed frequency 129.05 MHz, and PHI pilots would contact their radio operator on the Glomar Pacific or the Glomar Semi I, using their ARINC licensed frequency 131.4 MHz. While communicating with their company radio operator, the pilot would descend the helicopter to 400 feet m.s.l. within 1 mile from the oil rig, then turn and pass within 1/2 mile down-wind of the oil rig, and if the pilot did not have visual contact at this time (400 foot and 1/2 mile) he would execute a missed-approach and repeat the procedure or return to the base station.

Although there were no problems with traffic congestion in the air, due to the well defined helicopter corridors between the airports and the oil rigs, there was a communications problem with New York Center. Helicopter pilots had a difficult time communicating with New York Center on 132.15 MHz due to the continuous conversations between the center controllers and high altitude jet traffic in this very busy oceanic sector. The weaker, time critical, A/G communications transmissions from the low-altitude helicopter traffic could not compete with the stronger RF signals from the high-altitude jet aircraft, therefore, an ATC operational procedure was introduced to correct this problem.

A letter of agreement was written and coordinated by the Eastern Region's Airspace and Procedures Branch to transfer control of the airspace at 5,000 feet and below over the offshore New Jersey oil exploration area from New York center to the ACY tower. In addition to eliminating a communications congestion problem, this ATC procedure change also eliminated many transfer and coordination problems by having the helicopter pilot work a single ATC position for his entire flight. This ATC procedure change was found to be beneficial to both ATC and the helicopter pilot by greatly reducing the communications workload.

TEST RESULTS.

A series of test measurements were made to define the A/G communications coverage limits and investigate some reported A/G communications problems. The initial flight tests were made in the Sikorsky CH-53A helicopter (N39), shown in figure 12, using the flight test equipment shown in figure 13. Additional test measurements were made using the NAFEC CV580 Convair aircraft (N49) and the PHI and United Helicopters while they were operating in the offshore New Jersey oil exploration area.

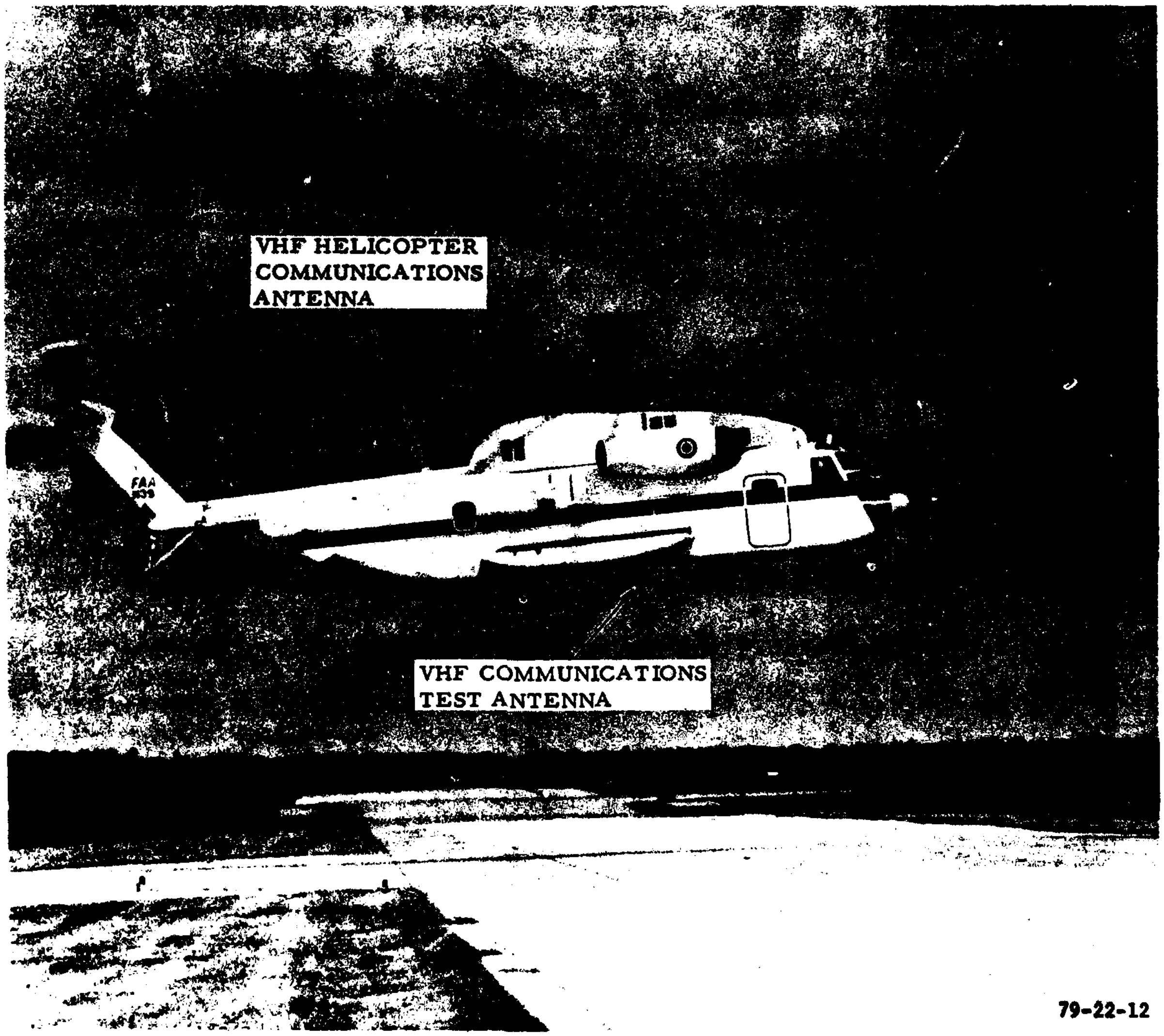

FIGURE 12. CH-53A HELICOPTER

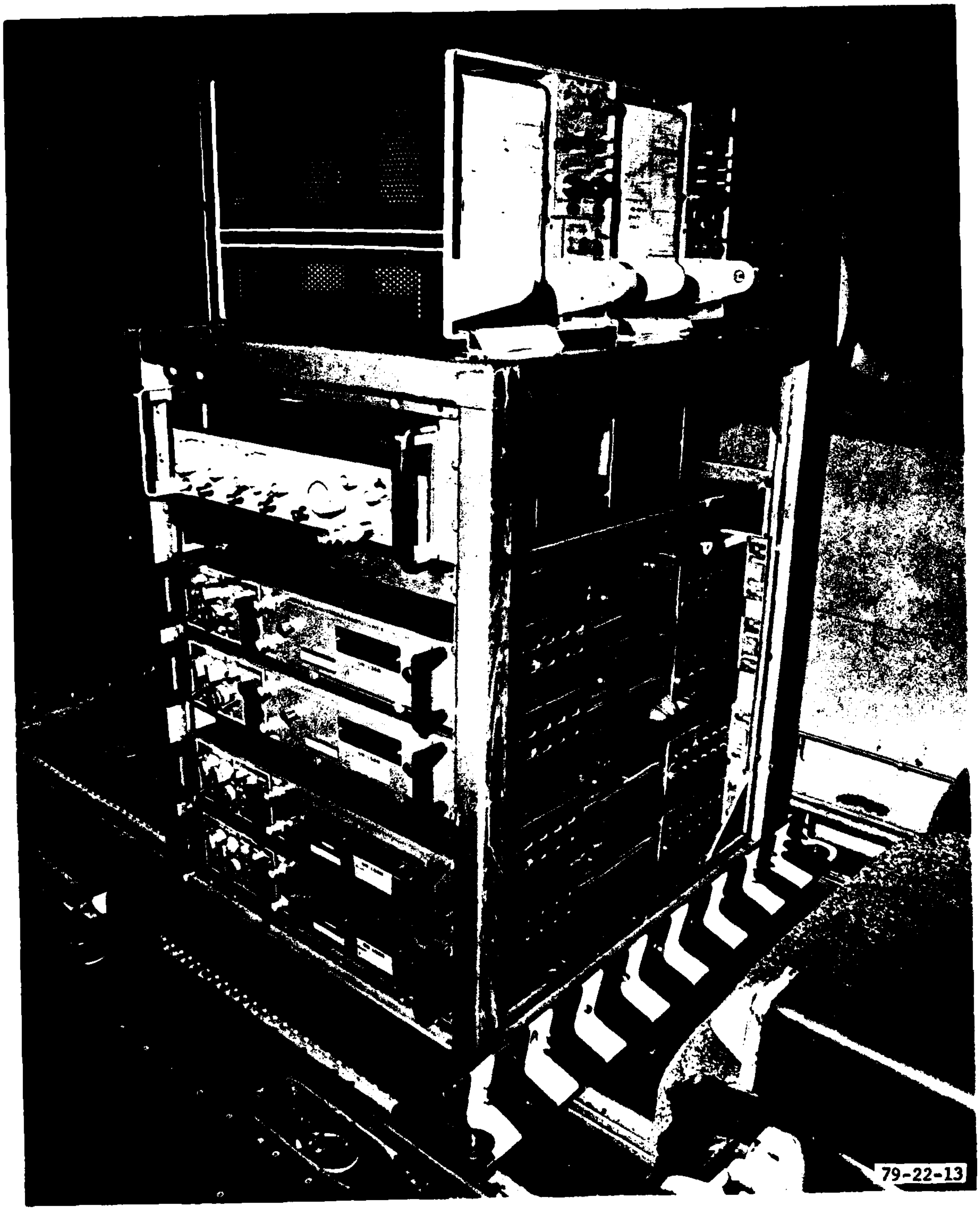

FIGURE 13. FLIGHT TEST EQUIPMENT

The first series of flight test measurements were made to investigate the helicopters VHF antenna radiating system. A Collins model AT-1108/ARC test antenna was installed on the bottom center section of N39 to minimize loading, lobing, and reflection problems. Both the test antenna and the helicopters communications system antenna were connected to the flight test receivers, which, in turn, had their automatic gain control (AGC) outputs connected to the flight test recorders. The AGC output voltage levels were calibrated on the flight check recorders in absolute (dBm) values using an HP-8640B signal generator.

The helicopter was then flown to a location approximately 1,000 feet east of the NAFEC experimental remote communications air/ground (RCAG) facility for flight test measurements. A 10-watt continuous wave (CW) signal was radiated on a VHF frequency 126.25 MHz from a vertically polarized dipole antenna on the RCAG sites east tower. With the helicopter hovering over a fixed point, 1,000 feet east of the RCAG site, at 50 feet AGL, the received signal levels were recorded as the helicopter was hovered through a 360° (degree) clockwise rotation, stopping at 15° increments to permit marking the recorded signal levels with heading information.

The same flight test procedure was repeated at 100 feet and 1,000 feet AGL to investigate shadowing problems at different angles of reception. The flight test data showed that signal levels from the bottom test antenna at 50 feet AGL varied between 4 dB and 7 dB below a standard gain dipole that was previously installed at this same location on a 50-foot crank-up tower to obtain a reference signal level. The signal levels from the upper helicopters communication system antenna, under the same test conditions, were found to vary between 4 dB and 25 dB below the standard gain dipole. The greatest loss of signal with the upper antenna was found to occur when the helicopter was facing the RCAG site and the engine and transmission assembly were between the source antenna and the helicopters system antenna. The greatest loss of signal with the lower test antenna occurred when the helicopter was facing north or south (turned 90° from the RCAG site) with the wheels lowered. An improvement of approximately 1 dB occurred with the test antenna and a slight deterioration of approximately 1 dB occurred with the communications system antenna at the higher altitudes. It is significant to note the great loss of signal which can occur due to the helicopters communications antenna location.

The second series of flight test measurements were designed to measure the offshore A/G communications coverage provided by ACY tower and New York center on their operational frequencies. Both helicopter operators had reported having problems communicating with ATC when they were between 40 and 60 miles from the Atlantic City VORTAC. To document the communications coverage out to the oil rigs and investigate the reported communications problems, the flight test equipment (shown in figure 13) was reinstalled in the CH-53A helicopter. Four receivers were connected to the helicopters lower test antenna through a receiver multicoupler and the receiver AGC outputs were again calibrated in absolute values on their respective recorder channels.

Recording of the A/G communications coverage provided by New York center from their Warren Grove communications facility, required the relocation of the oceanic sector frequency 132.15 MHz back to the Wildwood RCAG site and the installation of a VHF test frequency (133.125 MHz) at the Warren Grove site for the duration of the flight test. A 50-watt CW signal from an AN/GRT-21 transmitter was connected to the top dB-224E antenna through 400 feet of 7/8 inch low-loss foam-flex cable, providing 30 watts of RF energy at the antenna input terminals. The flight test data showed that a greater than 10 microvolt (-87 dBm) signal was present on the ACY 102° radial out to 80 nmi at 3,000 feet m.s.l. The reported communications problem on this frequency turned out to be a transmitter audio modulation problem which was found and corrected by the site technician.

To record the A/G communications coverage provided by Atlantic City tower on their approach/departure control frequency 118.35 MHz, the standby AN/GRT 21 50-watt transmitter at the remote transmitter site was keyed on for the duration of the flight test. The transmitter provided a measured 32 watts of RF energy at its elliptically polarized (swastika) antenna input terminals. The flight test data showed that a very weak RF signal was present between 40 and 60 nmi, as was reported by the helicopter operators. This communications coverage problem was due to antenna lobing and was corrected by replacing the swastika antenna with a new D-2276 FAA specified vertical dipole antenna.

In addition to the FAA operational frequencies, a 10-watt reference signal from the NAFEC experimental communications site on frequency 126.25 MHz and the PHI company radio frequency 131.4 MHz located at Bader Field were keyed on for the flight test. The flight test data showed a 6 dB per octave signal attenuation out to the radio horizon on the NAFEC test frequency and some nulls in the PHI operational frequency, due to shadowing by the Atlantic City beach front hotels and Convention Hall. PHI has since changed their operating frequency to 131.025 MHz and their antenna location to the roof of the Vassar Square apartment building which has improved their A/G communications out to the oil rigs.

In December 1978, control of the airspace out to and over the oil exploration area at 5,000 feet and below was transfered from New York center to the Atlantic City tower. The Atlantic City airport automatic terminal information service (ATIS) on VHF frequency 133.6 MHz was transferred to the ACY VOR frequency 108.6 MHz and frequency 133.6 MHz was then reassigned to the Warren Grove facility for offshore helicopter ATC service. To permit a more detailed investigation of A/G communications coverage over the oil exploration area from this location, the log-periodic antenna shown in figure 9 and an array of screen YAGI antenna shown in figure 10 were installed on the tower.

A third series of flight test measurements were made to investigate the A/G communications coverage to each of the oil drilling rigs. The flight test equipment was installed in the NAFEC convair (N49) to obtain the extended range required to cover the entire oil exploration area. A 50-watt transmitter on frequency 133.6 MHz was connected to the upper dB-224E antenna on the 300-foot tower level, a 10-watt transmitter on frequency 133.125 MHz was connected to the log-periodic antenna on the 200-foot tower level, and a 10-watt transmitter on frequency 126.25 MHz was connected to the array of screen YAGI antennas at the 100-foot tower level.

The flight test aircraft (N49) was flown to the Ocean Victory oil drilling rig via the oil route, then in a southwest direction over the other oil drilling rigs to the Pacesetter II returning to NAFEC via the SIE route.

After flying over the oil drilling rigs, the flight check aircraft would descend from the 3,000-foot en route altitude to 100 feet m.s.l. and check the communications coverage at the platform level. The flight test data at the Ocean Victory oil rig location showed that the RF signal from the log-periodic antenna at the 200-foot tower level faded out at 2,500 feet m.s.l. and the RF signal from the dB-224E antenna at the 300-foot tower level faded out at 700 feet m.s.l., and the RF signal from the array of screen YAGI antennas at the 100-foot tower level was still detectable at platform level. The flight test data at the Pacesetter II oil rig location showed the RF signal from the log-periodic antenna faded out at 2,000 feet m.s.l., the RF signal from the dB-224E antenna faded out a 1,200 feet m.s.l., and the RF signal from the array of screen YAGI antennas was present at the platform level. It is significant to note that the 10-watt signal from the 100-foot AGL antenna array was present at platform level and the 50-watt signal from the 300-foot AGL antenna faded out at 700 feet m.s.l.

An analysis of the flight test data showed that direct VHF communications between the oil drilling rigs and the tower are possible (using high gain directional antennas). This would permit the helicopter pilot to advise the tower from his radio room if for some reason he had to shut down and would not be able to meet his return ATC clearance time. The FAA specified VHF YAGI antenna, shown in figure 11, was installed on the Glomar Semi I oil drilling rig to test this concept. The operational test results indicate that satisfactory VHF A/G communications for helicopter IFR operations were obtained in the offshore New Jersey oil exploration area through the use of VHF high-gain directional antennas. These results which are based on both subjective and measurement data indicate results that exceed those which would normally be expected. Performance data from additional locations should be obtained as the unusual performance achieved in the offshore New Jersey tests may not be repeated to the same degree at another location.

CONCLUSIONS

Based on the data collected, analyzed, and presented in this report it is concluded that:

1. Over-the-horizon VHF A/G communications out to at least 100 nmi in the offshore New Jersey oil exploration area can be accomplished by using high-gain directional antennas.

2. The A/G communications system as presently installed is satisfactory for helicopter IFR operations in the offshore New Jersey oil exploration area.

3. The helicopter VHF antenna radiating system may be responsible for many of the reported A/G communications problems.

4. For low-altitude offshore helicopter operations which extend to the radio horizon, special attention should be given to the ground station equipment, especially the antennas, to assure maximum possible signal strength at the horizon in the required direction.

RECOMMENDATIONS

Based on the test results obtained during this test and evaluation effort, it is recommended that:

1. A follow-on study be initiated at NAFEC to investigate improvements to the helicopter VHF communications radiating system.

2. NAFEC test and evaluation support be made available to other FAA facilities that require low-level extended range A/G communications.